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INSTRUCTION MANUAL

MODEL 7031

T1 ERROR RATE MONITOR

NORTHEAST ELECTRONICS

Airport Road, Concord, New Hampshire 03301 • (603) 224-6521

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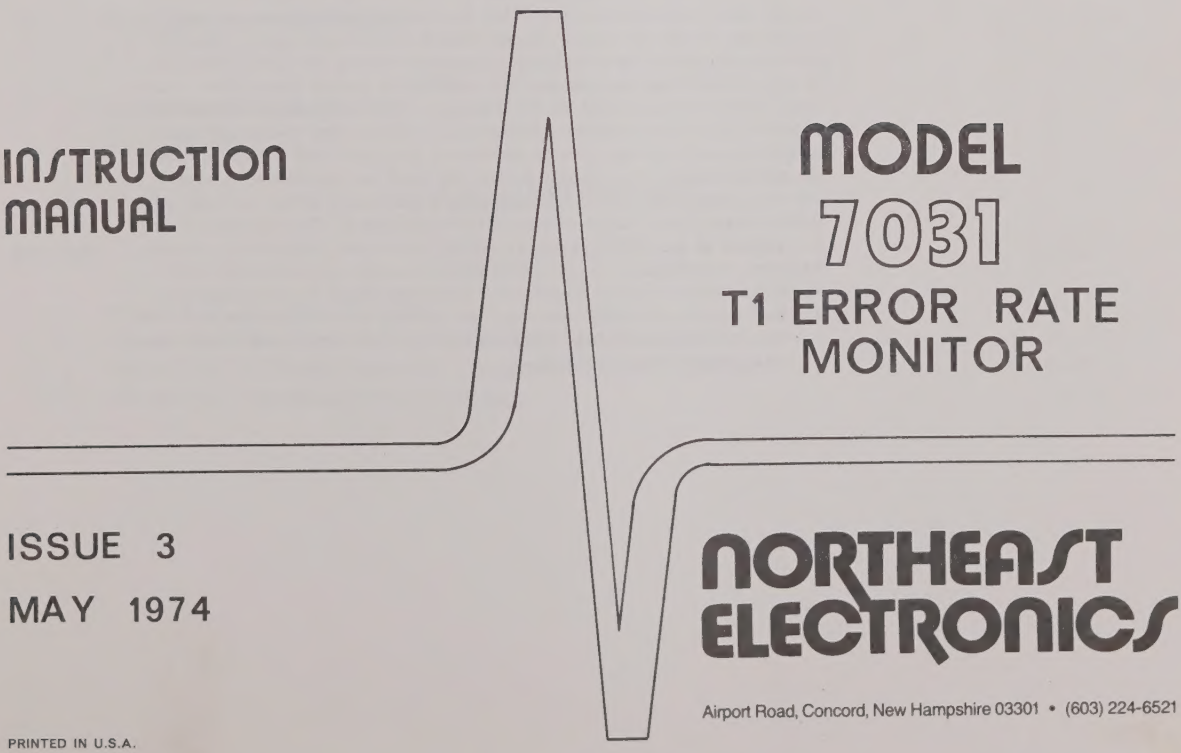

ISSUE 3

MAY 1974

NORTHEAST ELECTRONICS

Airport Road, Concord, New Hampshire 03301 • (603) 224-6521

PRINTED IN U.S.A.

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TABLE OF CONTENTS

SECTION	TITLE	PAGE
1	**DESCRIPTION**	1–1
	1.1 Introduction	1–1
	1.3 Special Features	1–1
	1.5 Power Requirements	1–1
2	**SPECIFICATIONS**	2–1
	2.1 Introduction	2–1
3	**OPERATING INSTRUCTIONS**	3–1
	3.1 Introduction	3–1
	3.3 Operating Procedures	3–2
	3.4 Error Seconds Count	3–2
	3.6 Individual Error Count	3–3
4	**CIRCUIT DESCRIPTION**	4–1
	4.1 Introduction	4–1
	4.3 Overall Circuit Description	4–1
	4.5 Detailed Circuit Description	4–1
	4.6 Signal Input Circuit	4–1
	4.8 Switching and Detection Circuit	4–1
	4.10 Pulse Monitoring Circuits	4–1
	4.13 Error Monitoring Circuits	4–2
	4.15 Power Supply and Lost Power Circuit	4–2
5	**MAINTENANCE AND CALIBRATION**	5–1
	5.1 Introduction	5–1
	5.3 Calibration	5–1
	5.4 Test Equipment Required	5–1
	5.6 Calibration Procedure	5–1
6	**ELECTRONIC PARTS LIST**	6–1
	6.1 Introduction	6–1
7	**SCHEMATIC DIAGRAMS**	7–1
	7.1 Introduction	7–1

LIST OF ILLUSTRATIONS

FIGURE	TITLE	PAGE
1–1	Model 7031 Error Rate Monitor	1–0
3–1	Model 7031 Front Panel Controls,Indicators, and Connectors	3–4
6–1	Model 7031 PC Board Assembly, Component Location Diagram	6–3
7–1	Model 7031 Overall Schematic Diagram	7–2

LIST OF TABLES

TABLE	TITLE	PAGE
2–1	Model 7031 Specifications	2–1
3–1	Front Panel Controls,Indicators and Connectors	3–1
3–2	Conversion of Timer Settings to Seconds	3–3
6–1	List of Manufacturers	6–1
6–2	Model 7031 Overall Parts List	6–2
6–3	Model 7031 PC Board Assembly Parts List	6–3

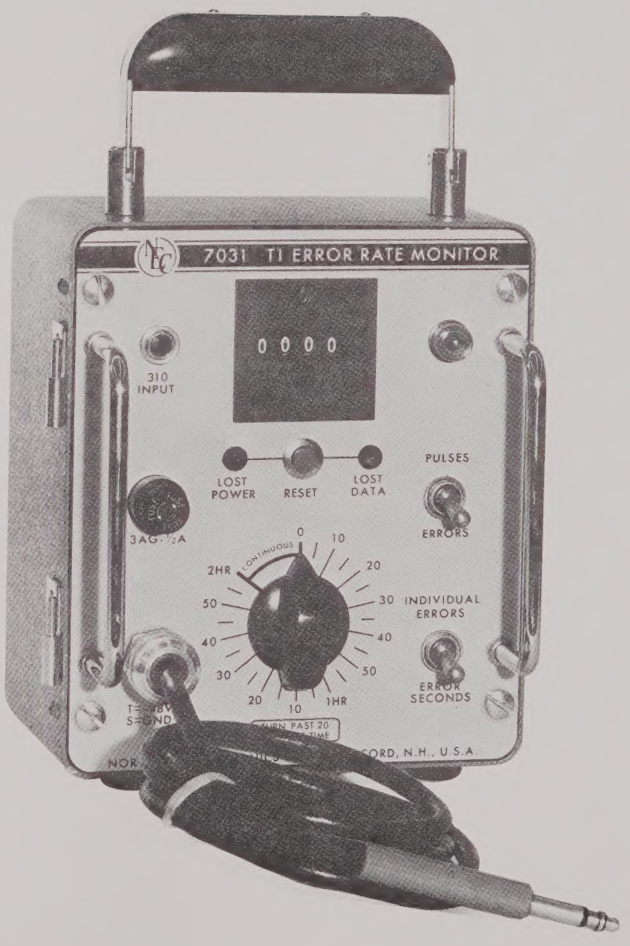


Figure 1—1. Model 7031 T1 Error Rate Monitor.

SECTION 1

DESCRIPTION

1.1 INTRODUCTION.

1.2 The Northeast Electronics Model 7031 T1 Error Rate Monitor, Figure 1—1, is a portable test set capable of counting and displaying the number of error seconds at a monitor jack on a T1 office repeater. Error seconds may be counted continuously or programmed for a preset period of time up to two hours. The primary function of the Model 7031 is to provide data for computing the percentage of error-free seconds in the signal of a T1 transmission facility. Error-free seconds percentage is generally regarded as a criterion of excellence for transmission of digital information. In addition to counting error seconds (bipolar violations separated by at least one second), the Model 7031 is capable of counting individual errors (bipolar violations) separated by 100 milliseconds or more.

1.3 SPECIAL FEATURES.

1.4 When the preset period is used for error counting, the count terminates automatically upon expiration of the selected period and total errors are displayed until cleared by resetting the counter manually. An indicator lamp provides a continuous indication of the presence (or absence) of errors or pulses, depending upon the operating mode selected. Two other indicator lamps will indicate loss of data and temporary loss of power, either of which would invalidate a count.

1.5 POWER REQUIREMENTS.

1.6 The Model 7031 is powered by the —48V central office battery. A 310 type plug on a permanently attached cable assembly is inserted into an office battery jack to activate the 7031 test set.

SECTION 2

SPECIFICATIONS

2.1 **INTRODUCTION.**

2.2 Table 2—1 lists the electrical and physical specifications for the Model 7031 T1 Error Rate Monitor.

Table 2—1. Model 7031 Specifications.

INPUT	
Signal:	From standard T1 office repeater MON jack, using 310 to 310 patch cord not more than 10 feet long.
Impedance:	Approximately 2100 ohms bridging, dc—blocked input transformer.
ERROR RATE MONITORING	
Counter Type:	Electro-mechanical with manual reset. 10 counts per second maximum limited by electronic circuit. Maximum total count display of 9999.
Counter Timing:	Continuous or with automatic turn-off and audible signal after preselected period up to two hours.
Error Indicator Lamp:	Flashes once for each error or error burst separated by 100 milliseconds or more, 10 per second maximum.
PULSE MONITORING	
Pulse Indicator Lamp:	Flashes continuously at maximum rate of 10 per second.
Lost Data Lamp:	Lights and remains on if pulses are absent for 1.2 seconds or more. Must be reset manually.
POWER REQUIREMENTS AND MONITORING	
Voltage:	—48V central office battery.
Current:	300 milliamperes maximum.
Lost Power Lamp:	Lights and remains on when power is restored after a momentary loss. Must be reset manually.
AMBIENT TEMPERATURE RANGE	
Operation:	0°C to +60°C (32°F to +140°F)
PHYSICAL FEATURES	
Dimensions:	6 in. d x 7 in. h x 6 in. w (152.4mm d x 177.8mm h x 152.4mm w)
Weight:	4 1/2 pounds (2.04 kg)

SECTION 3

OPERATING INSTRUCTIONS

3.1 **INTRODUCTION.**

3.2 The functions of front panel controls, indicators and connectors illustrated on Figure 3—1 are described in Table 3—1, and operating instructions are provided in paragraphs 3.3 through 3.7. No installation instructions are required.

Table 3—1. Front Panel Controls, Indicators and Connectors.

REF DESIG	CONTROL,INDICATOR OR CONNECTOR	FUNCTION
DS1	Errors & pulses indicator lamp	Flashes once for each error or error burst detected and flashes steadily at a rate of approximately 10 flashes per second when continuous errors are detected (switch S1 in ERRORS position). Flashes steadily when pulses are detected (switch S1 in PULSES position).
DS2	LOST POWER indicator lamp	Lights to indicate loss and subsequent restoration of —48V power to the Model 7031. Remains lit until switch S3 is depressed.
DS3	LOST DATA indiactor lamp	Lights when T—carrier input signal is lost or is below threshold level for 1.2 seconds or more. Remains lit until switch S3 is depressed.
F1	3AG—1/2A fuse	Protects the power circuitry against excessive current.
J1	310 INPUT jack	Accepts 310 to 310 cord for connecting to MON jack of T1 office repeater. Length of cord is 10 feet maximum.
M1	Counter	Counts error seconds, or error bursts at a maximum rate of 10 per second, depending on position of switch S2, up to a maximum total of 9999. Count can be cleared (reset to 0000) by depressing mechanical pushbutton on front of counter. DO NOT RESET while counter is energized.
M2	CONTINUOUS or 0 to 2HR timer	Controls counter M1 as follows: When set to 0, turns off counter M1; when turned counterclockwise to CONTINUOUS, enables counter M1 for continuous operation. When turned clockwise to desired preset time interval (up to two hours) enables counter M1 for timed operation.
P1	T = —48V S = GND plug (including cable assembly and entry)	Provides 310 plug on power cord for connection to —48V central office battery jack.
S1	PULSES/ERRORS toggle switch	Selects circuit for measuring PULSES or ERRORS. PULSES position also disables counter M1.

Table 3—1. Continued

REF DESIG	CONTROL,INDICATOR OR CONNECTOR	FUNCTION
S2	INDIVIDUAL ERRORS/ERROR SECONDS toggle switch	Selects counter response of 1 per second maximum in ERROR SECONDS position or allows maximum counter response of approximately 10 per second in INDIVIDUAL ERRORSposition. Does not affect indicator lamp DS1 operation.
S3	RESET momentary pushbutton switch	Resets control circuits for LOST POWER and LOST DATA indicator lamps DS2 and DS3.

3.3 **OPERATING PROCEDURES.**

3.4 **ERROR SECONDS COUNT.**

3.5 The purpose of counting error seconds is to determine the number of one second intervals in which errors occur in a T1 carrier signal during a preset counting period. Error-free seconds are computed by subtracting the counted error seconds from the total number of seconds in the preset counting period.

ACTION	RESULT
a. Insert power plug P1 on power cord into customer-supplied 310 type central office battery jack. Tip wired to −48V and sleeve wired to ground.	LOST POWER lamp DS2 and LOST DATA lamp DS3 will light.
b. Using a 310 to 310 patch cord, connect signal to be measured from T1 office repeater MON jack to 310 INPUT jack J1 on Model 7031. Cord length must not exceed 10 feet.	
c. Depress and release RESET switch S3.	LOST POWER and LOST DATA LAMPS extinguish.
d. Set PULSES/ERRORS switch S1 to PULSES position.	Lamp DS1 flashes steadily at a rate of approximately 10 per second if pulses are present.
e. Set PULSES/ERRORS switch S1 to the ERRORS position.	Lamp DS1 flashes once for each occasional error or error burst, or flashes steadily at a rate of approximately 10 per second for continuous errors.
f. Set INDIVIDUAL ERRORS/ERROR SECONDS switch S2 to ERROR SECONDS position.	No change from step e.
g. Depress pushbutton on counter M1.	Counter M1 clears to display 0000.

NOTE

If desired setting of timer M2 in step h is less than 20, turn control clockwise past 20 then counterclockwise to desired setting.

h. Turn CONTINUOUS/0 — 2HR timer M2 clockwise to setting corresponding to the number of minutes for which error seconds are to be counted and displayed. (See Table 3—2 for conversion of counter M2 settings to seconds).	Counter M1 advances one count for each second in which one or more bi-polar violations (errors) occur.
i. When CONTINUOUS/0 — 2HR timer M2 times out to 0 position, observe LOST POWER and LOST DATA lamps DS2 and DS3.	When either lamp DS2 or DS3 is lit, count displayed on counter M1 is invalid and steps g and h must be repeated before proceeding to step j.
j. Observe display on counter M1.	The number of error seconds that occurred during time selected in step h is displayed on counter M1.
k. Subtract number observed in step j from number of seconds selected in step h. See Table 3—2 for conversion to seconds of counter M2 settings, which are marked in minutes.	The difference between displayed number and selected time is error-free seconds. Percentage of error-free seconds is determined by dividing selected time (in seconds) into error-free seconds.

Table 3—2. Conversion of Timer Settings to Seconds.

TIMER M2 SETTINGS (MINUTES)	CONVERSION (SECONDS)
10	600
20	1200
30	1800
40	2400
50	3000
1HR	3600
10	4200
20	4800
30	5400
40	6000
50	6600
2HR	7200

3.6 INDIVIDUAL ERROR COUNT.

3.7 The purpose of counting individual errors is to make a relatively quick check of the error rate on a T1 signal. The procedure in paragraph 3.4 can be used for this mode of operation, except that switch S2 must be set to the INDIVIDUAL ERRORS position in step f. Also the results specified in steps h and j must be modified to reflect individual errors rather than error seconds, and step k does not apply. Individual errors can be counted by using the CONTINUOUS position of timer M2 and timing the count with a stopwatch.

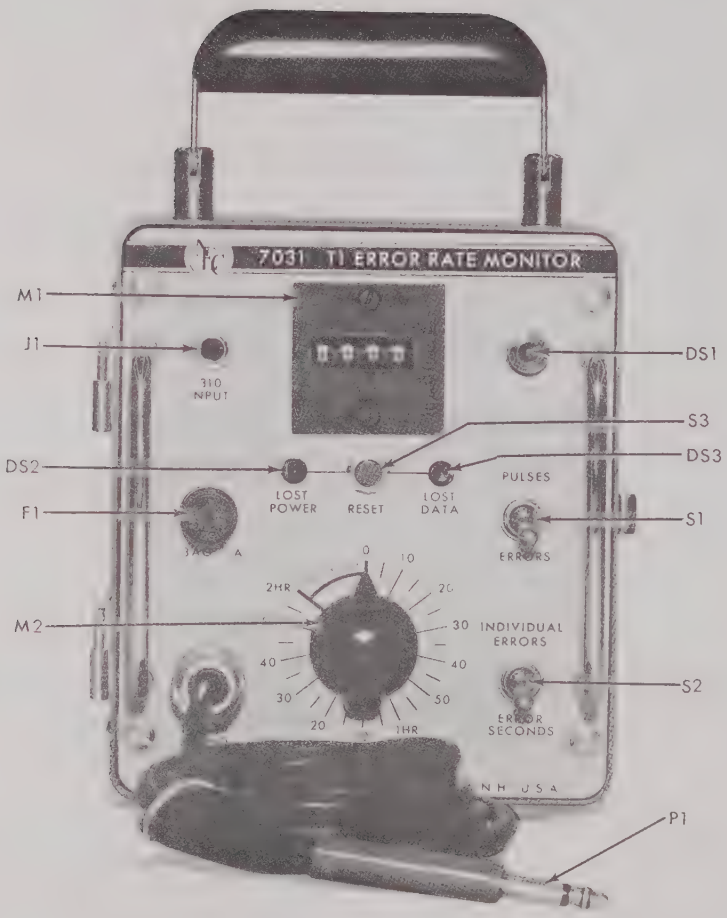


Figure 3—1. Model 7031 Front Panel Controls, Indicators and Connectors.

SECTION 4

CIRCUIT DESCRIPTION

4.1 INTRODUCTION.

4.2 Circuit descriptions in this section provide all necessary principles of operation for a thorough understanding of the Model 7031 logic and electronic functions. The overall circuit description in paragraph 4.4 identifies the function of circuit groups and detailed descriptions in paragraphs 4.6 through 4.17 describe performance of the functions in their logical sequence.

4.3 OVERALL CIRCUIT DESCRIPTION.

4.4 Refer to Figure 7—1. Transformer T1 and associated circuitry provide impedance matching and coupling between 310 INPUT jack J1 and switching transistors Q1 and Q2. J—K flip-flop U2 and exclusive OR gate U3 detect errors in a T1 signal received at jack J1, and NOR gates U1C and U1D detect pulses. Detected pulses control the lost data circuitry, which consists of one-shot multivibrator U6, R—S flip-flop (latch) U7C and U7D, and LOST DATA light emitting diode DS3. Depending upon the position of PULSES/ERRORS switch S1, pulses or errors are connected to monitor rate circuits U4 and U5. One-shot multivibrators U4A and U4B provide error monitoring at a one-second rate and one-shot multivibrators U5A and U5B provide error or pulse monitoring at a 100-millisecond (0.1 second) rate. Driver transistors Q5 and Q6 (for lamp DS1) are controlled by the 0.1-second monitor rate circuit at all times. Depending upon the position of INDIVIDUAL ERRORS/ERROR SECONDS switch S2, driver transistors Q3 and Q4 (for counter M1) are controlled by either the 0.1-second monitor rate circuit or the 1.0-second monitor rate circuit. The lost power circuit, consisting of R—S flip-flop U7A and U7B, capacitor C8, diode CR3, and LOST POWER light emitting diode DS2, is controlled by —5 volt regulator U8 and associated circuitry.

4.5 DETAILED CIRCUIT DESCRIPTION.

4.6 SIGNAL INPUT CIRCUIT.

4.7 Refer to Figure 7—1. The T1 pulse train at 310 INPUT jack J1 enters the monitoring circuit through buildout resistors R1 and R2 and transformer T1. The primary of transformer T1 is dc blocked by capacitor C1. Input bridging impedance is approximately 2100 ohms. The center tap of the transformer secondary is biased just below the switching threshold of transistors Q1 and Q2 by resistor R3 and diode CR1. Capacitor C2 provides bias voltage filtering.

4.8 SWITCHING AND DETECTION CIRCUITS.

4.9 Each positive input pulse to transformer T1 causes Q1 to conduct and each negative input pulse to transformer T1 causes Q2 to conduct. NOR gates U1A and U1B invert the unipolar pulses from the collectors of Q1 and Q2 respectively. These signal bits are applied to the error and pulse detectors in parallel. For each signal bit, pulse detector U1C and U1D produces a positive pulse that is applied to the PULSES position of switch S1 and to the clock input (U2—1) of J—K flip-flop U2. Flip-flop U2 simply toggles along with the signal input, changing state each time pulse detector output terminal U1D—13 goes negative. During error-free operation, the Q and $\overline{Q}$ outputs of U2 alternately go high at the end of every signal pulse. Thus, during the time a signal pulse is present, the respective Q or $\overline{Q}$ input to U3A or U3B is low and the outputs of U3A and U3B are both high, causing the output of U3C to be low. This results in a low level at U3C—8 when the input signal is error-free. During bipolar violation, however, pulses are added or deleted, resulting in adjacent pulses on either the J or K input of U2. For example, assume that the error occurs in two adjacent time slots on the J input of U2. The normal first pulse sets Q high and the erroneous second pulse has no effect on the flip-flop. Thus, during the error pulse, both inputs to U3A are high and its output goes low. This causes the output of U3C to go high, designating an error.

4.10 PULSE MONITORING CIRCUITS.

4.11 When switch S1 is in the PULSES position, the first pulse from NOR gate U1D—13 triggers one-shot multivibrators U4B and U5B. Only U5B is significant to this discussion. The Q output at U5B—10 goes high for 50 milliseconds and turns on drivers Q5 and Q6, causing indicator lamp DS1 to light for 50 milliseconds. The output at U5B—10 also triggers one-shot multivibrator U5A, which prevents U5B from being retriggered for 100 milliseconds (50 milliseconds after DS1 turns off.) Therefore, in the presence of continuous pulses, the duty cycle of lamp DS1 is limited to 50 percent.

4.12 Pulses at NOR gate U1D—13 trigger one-shot multivibrator U6, causing the Q output to go high to terminal 13 of R—S flip-flop U7C/D. The Q output of remains high as long as trigger pulses appear at U6—5 once every 1.2 seconds or more frequently. Assuming a high at U7C—8, which will always be the case when RESET switch S3 is depressed, U7D—11 is low and

LOST DATA light emitting diode DS3 is extinguished. If no pulses appear at U1D—13 for a period in excess of 1.2 seconds, the Q output of U6 will go low and change the flip-flop output at U7C—8 from high to low. This low will cause LOST DATA light emitting diode DS3 to light, indicating invalidity of the error rate count in which the LOST DATA indication occurred.

4.13 ERROR MONITORING CIRCUITS.

4.14 When switch S1 is in the ERRORS position, an error pulse at U3C—8 will trigger one-shot multivibrators U4B and U5B simultaneously. The operation of U4A and B is the same as described for U5A and B in paragraph 4.11, except that U4B is prevented from being retriggered for one second rather than for 100 milliseconds. Potentiometer R7 adjusts the one-second interval. Depending upon the position of switch S2, the output of U4B or U5B will be applied to driver transistors Q3 and Q4. These drivers enable counter M1 to increment when time M2 is turned on. Switch S1 must be set to the ERRORS position to apply —48 volts to counter M1. The counter will not increment on pulses. Counter M1 will increment on bipolar violations separated by at least one second when switch S2 is set to the ERROR SECONDS position, and will increment on bipolar violations separated by at least 100 milliseconds when switch S2 is set to the INDIVIDUAL ERRORS position.

4.15 POWER SUPPLY AND LOST POWER CIRCUIT.

4.16 Power Supply. The —5 volt dc power required to operate the logic circuits is derived from voltage regulator U8 and associated components. Primary power to the voltage regulator is supplied by a —48 volt central office battery, which is protected by 3AG 1/2A fuse F1. Resistor R101 serves as a voltage drop, and diode CR4 provides reverse polarity protection. Zener diode CR5 limits the input voltage at U8 to —22 volts. Capacitors C9 and C10 filter out transients that may be present on the battery bus, and capacitor C11 provides output filtering.

4.17 Lost Power Circuit. When power is applied initially to the Model 7031, capacitor C8 builds up a positive (high) charge that is applied to terminal 1 of R-S flip-flop U7A/B. Before this charge can become high enough to be inverted by U7A, the two highs at U7B—4 and 5 (one high from U7A—3 and the other from ground via resistor R21) force U7B—6 to go low and cause LOST POWER light emitting diode DS2 to light. By depressing RESET switch S3, a low (—5V) is connected to U7B—5 and causes U7B—6 to go high. This high extinguishes LOST POWER diode DS2 and also is applied to U7A—2. Capacitor C8 has charged high at U7A—1, and the two high inputs force the output at U7A—3 to go low. Lost power R—S flip-flop U7A/B remains latched in this state until power is lost and subsequently restored, at which time LOST POWER diode DS2 will light to indicate invalidity of any error rate count in which the LOST POWER indication occurred.

SECTION 5

MAINTENANCE AND CALIBRATION

5.1 INTRODUCTION.

5.2 No routine maintenance is prescribed for the Model 7031. The calibration procedure, which may be performed periodically (e.g., annually) or when a malfunction occurs, for the 1.0—second monitor rate circuit is presented in paragraph 5.7.

5.3 CALIBRATION.

5.4 TEST EQUIPMENT REQUIRED.

5.5 Only one item of test equipment is required: a Tektronix DC503 Electronic Time Interval Counter, or the equivalent having an accuracy of 1%.

5.6 CALIBRATION PROCEDURE.

5.7 Adjust potentiometer R7 in the 1.0—second monitor rate circuit as described in the following procedure. Refer to Figure 6—1 for the location of R7 and PCB terminals.

a. Loosen four retaining screws on front panel of Model 7031 and remove unit from case.

b. Connect power and T carrier signal to Model 7031 as described in steps a and b of paragraph 3.5.

c. Set PULSES/ERRORS switch S1 to PULSES position.

d. Set INDIVIDUAL ERRORS/ERROR SECONDS switch S2 to ERROR SECONDS position.

e. Connect Electronic Time Interval Counter (ETIC) described in paragraph 5.5 to Model 7031, with ground at terminal 1 and probe at terminal 8 of PC board. Turn on and set up ETIC to measure pulse period (time interval).

f. Observe display on ETIC. If 1000 milliseconds $\pm$ 2% is displayed, the 1.0-second monitor rate circuit is properly adjusted. If 1000 milliseconds $\pm$ 2% is not displayed, carefully remove glyptal and adjust potentiometer R7 on PC board until ETIC displays 1000 milliseconds. Secure adjustment by applying glyptal to adjusting screw on potentiometer R7.

g. Disconnect ETIC, signal and power and secure Model 7031 in its case.

SECTION 6

ELECTRONIC PARTS LIST

6.1 **INTRODUCTION.**

6.2 This section contains a complete listing of replaceable electronic parts for the Model 7031 T1 Error Rate Monitor. Table 6—1 is a list of Federal Supply Code of Manufacturers (FSCM) for replaceable parts. The parts lists, Tables 6—2 and 6—3, are arranged alpha-numerically by reference designation. Component location diagram Figure 6—1 is included to facilitate maintenance.

Table 6—1. Model 7031 List of Manufacturers.

Code No.	Manufacturer
01121	Allen Bradley, Milwaukee, Wis. 53212
01295	Texas Instruments Inc., Dallas, Texas 75222
04009	Arrow Hart, Hartford, Conn.
04713	Motorola Inc., Pheonix, Az. 85008
05397	Union Carbide Corp., Cleveland, Ohio 44101
06111	Fairchild Controls, Mountain View, Ca.
07047	Ross Milton Co., Southampton, Pa. 18966
12065	Transitron Electronics Corp., Boston, Ma 02128
12697	Clarostat Inc., Dover, N.H. 03820
13606	Sprague Electric Co.,Concord, N.H. 03301
19701	Electra/Midlands, Mineral Wells, Texas 76067
28480	Hewlet-Packard Co., Palo Alto, Ca. 94304
49671	RCA Corp., New York, N.Y. 10020
71279	Cambion Corp., Cambridge, Ma. 02138
71400	Bussman, St Louis, Mo. 63017
71590	Centralab Electronics, Milwaukee, Wis. 53201
72619	Dialight Corp., Brooklyn, N.Y. 11237
72663	General Controls co., Boston, Ma. 02134
73138	Beckman Inc., Fullerton, Ca. 92634
75915	Littelfuse Inc., Des Planes, Ill. 60016
79919	Rhodes Inc., Hartford, Conn. 06101
80368	Sylvania Electric Co., New York, N.Y. 10017
82389	Switchcraft Inc., Chicago, Ill. 60630
94304	Lunn Laminates Inc., Wyandanch, L.I.
95073	Doranic, Westerly, R.I. 02891

Table 6—2. Model 7031 Overall Parts List.

REFERENCE DESIGNATOR	DESCRIPTION	MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C101	1UF 10% 35V	05397	T330A105K035AS	310001051
DS1	40MA 00 28V	80368	327	730000500
DS2	12MA 5V	H.PACKARD	5082-4860	564500800
DS3	SAME AS DS2			
F1	.5A 00 250V	75915	3AG	863100300
J1	MT332B	SWCRFT	5J-1583	650403100
M1	48V	DURANT	4-Y-41314-403-MEQ	728000600
M2	TIMER 2-HR W/HOLD+BELL	MH RHODES	71528-J	961200500
P1				931300100
R101	120- 10W 5%	CLAROSTAT	VC10F	210601215
S1	DPDT 6A 00 125V	04009	ST22N	620100600
S2	SAME AS S1			
S3	SPDT RED	82389	903	635400100
WT1	MALE 4-40X1/4 2-TURRET	CAMBION	2045-1	850300200
WT2	SAME AS WT1			
WT3	SAME AS WT1			
XDS1		72619	101-8430-0933-201	828000700
XDS2	KIT, LED, PANEL MTG. HDWE	ELDEMA	Q-084-3D	850501100
XDS3	SAME AS XDS2			
XF1	FUSEHOLDER,3AG PANEL	71400	HKP	863000100

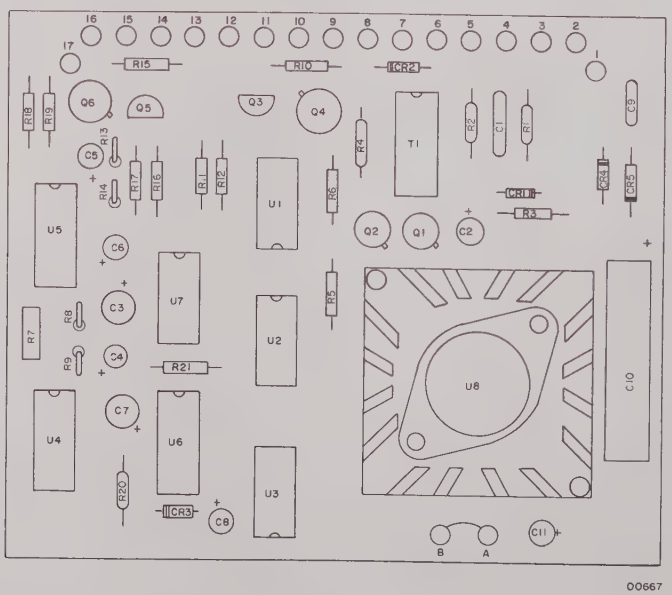


Figure 6—1. Model 7031 PC Board Assembly, Component Location Diagram.

Table 6—3. Model 7031 PC Board Assembly Parts List.

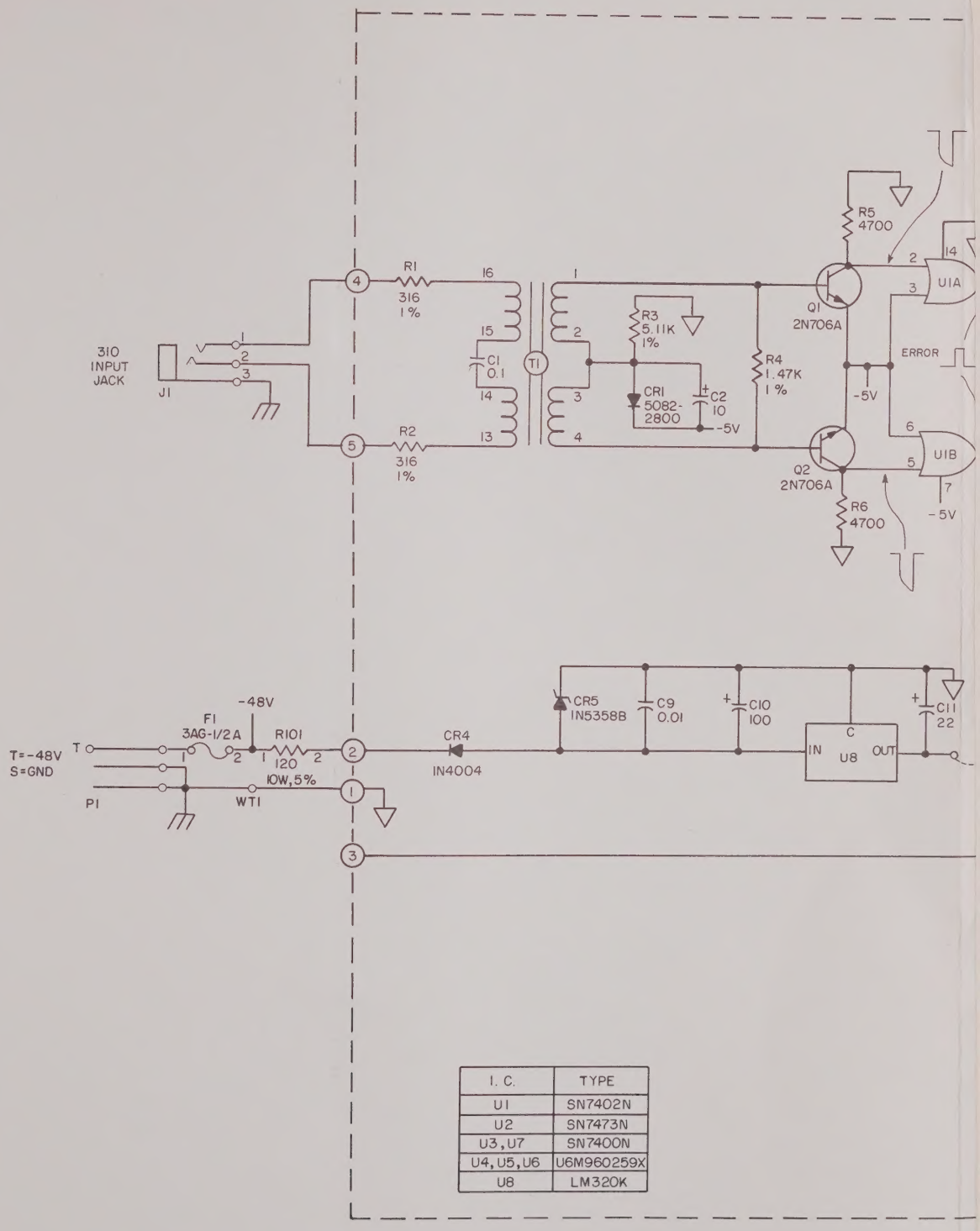
REFERENCE DESIGNATOR	DESCRIPTION				MFGR.	MFGR. PART NO.	N.E.C. PART NO.
C1	.1UF		20%	500V	13606	5GA-P10	330401040
C2	10UF		10%	25V	SPRAGUE	196D106X9025KA1	310801061
C3	100UF		10%	10V	SPRAGUE	196D107X9010PE4	310801070
C4	SAME AS C2						
C5	SAME AS C2						
C6	SAME AS C2						
C7	SAME AS C3						
C8	SAME AS C2						
C9	.01UF		20%	50V	71590	CK-103	330701030
C10	100UF		00	50V	13606	TE-1309	300201072
C11	22UF		20%	10V	13606	196D226X0010JA1	310802260
CR1	70V BRKDOWN				94304	5082-2800	561550820
CR2	DO41	3		400V	12065	IN4004	560040040
CR3	DO35	500MW	00	20V	12065	1N4148	560041480
CR4	SAME AS CR2						
CR5	CASE 17	5W	5%	22V	MOTOROLA	IN5358B	562053580
Q1	TO18MSA	300MW	00	24V	72663	2N706A	550007060
Q2	SAME AS Q1						
Q3	TO92AFA	310MW	00	25V	04713	MPS6515	550065150
Q4	TO5MSS	5W	00	65V	49671	2N4036	552040360
Q5							550055150
Q6	SAME AS Q4						
R1	316-	1/8W	1%		19701	MF5C	220231601
R2	SAME AS R1						
R3	5110-	1/8W	1%		19701	MF5C	220251111
R4	1470-	1/8W	1%		19701	MF5C	220214711
R5	4.7K	1/2W	10%		01121	TYPE EB	200204726
R6	SAME AS R5						
R7	20K	1/2W	10%	200V	HELIPOT	72XWR20K	232702031
R8	21.5K	1/8W	1%		19701	MF5C	220221521
R9	16.2K	1/8W	1%		19701	MF5C	220216221
R10	10K	1/2W	10%		01121	TYPE EB	200201036
R11	1K	1/2W	10%		01121	TYPE EB	200201026
R12	SAME AS R11						
R13	32.4K	1/8W	1%		19701	MF5C	220232421
R14	SAME AS R9						
R15	SAME AS R10						
R16	SAME AS R11						
R17	SAME AS R11						
R18	1.2K	1/2W	10%		01121	TYPE EB	200201226
R19	SAME AS R18						
R20	38.3K	1/8W	1%		19701	MF5C	220238321
R21	SAME AS R11						
T1	XFMR,DUAL PULSE,16DILP						A440200100
U1	14DILP		00	500V	01295	SN7402N	510074020
U2	14DILP		00		01295	SN7473N	510074730
U3	14DILP		00		01295	SN7400N	510074000
U4	16PDIL				FAIRCHILD	U6M960259X	510096025
U5	SAME AS U4						
U6	SAME AS U4						
U7	SAME AS U3						
U8				5V	NAT SEMI	LM320K	500003200
XQ4	TRANSOPAD,1/8 PLASTIC				07047	10109	860300200
XQ6	SAME AS XQ4						

SECTION 7

SCHEMATIC DIAGRAMS

7.1 INTRODUCTION.

7.2 Figure 7—1 schematically illustrates all circuitry in the Model 7031.



I. C.	TYPE
U1	SN7402N
U2	SN7473N
U3, U7	SN7400N
U4, U5, U6	U6M960259X
U8	LM320K

NOTES:

1. UNLESS OTHERWISE INDICATED:
   CAPACITOR VALUES ARE IN MICROFARADS
   RESISTOR VALUES ARE IN OHMS.

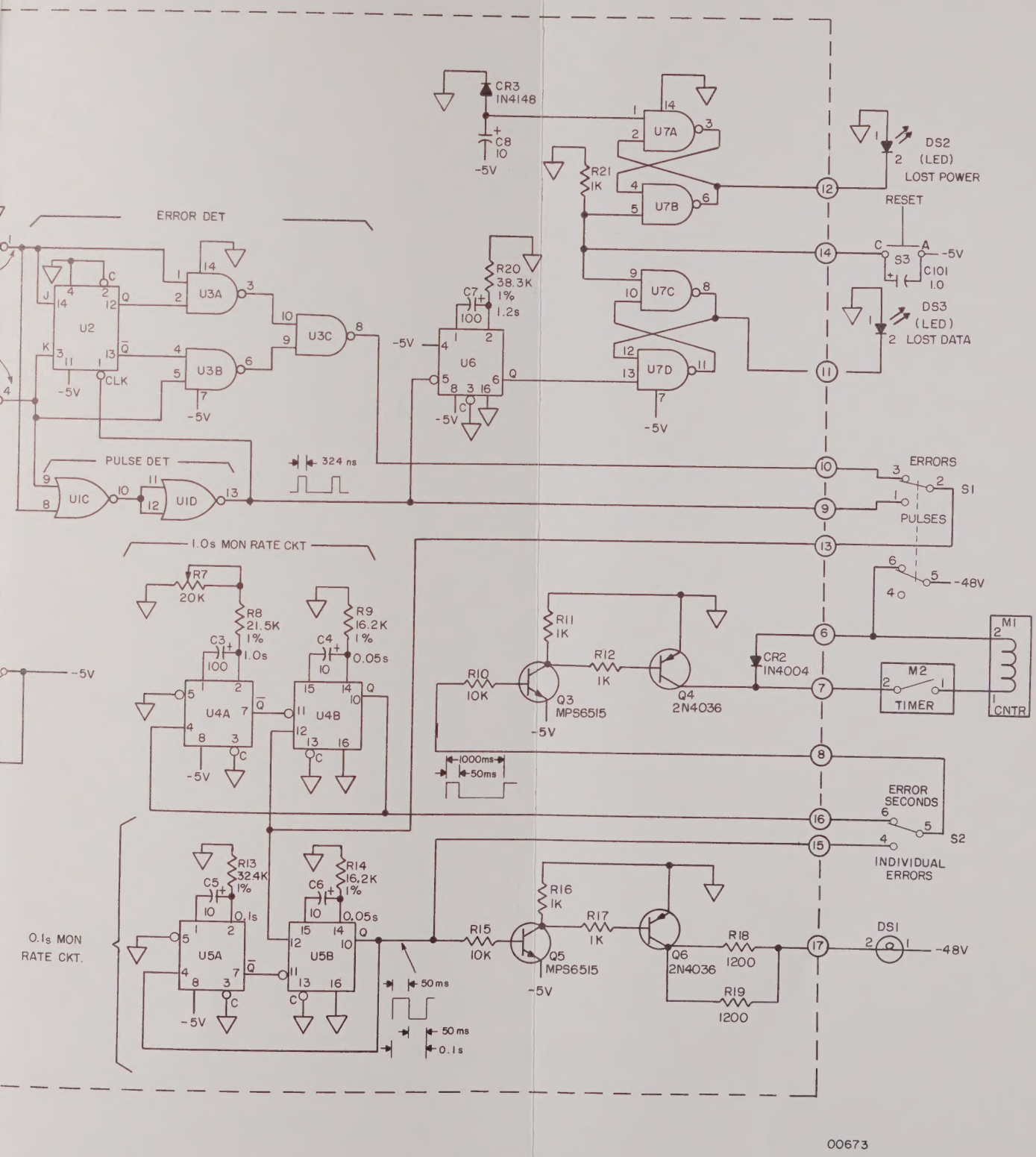


Figure 7—1. Model 7031 Overall Schematic Diagram.